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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/033,997 | 12/19/2001 | Chris R. Franklin | | 1881 |

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| EXAMINER | |
|---|---|
| TSAI, SHENG JEN | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2186 | |

DATE MAILED: 12/14/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/033,997 | FRANKLIN ET AL. | |
| | Examiner | Art Unit | |
| | Sheng-Jen Tsai | 2186 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *19 December 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-11* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/19/2001*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

1. Claims 1-11 are presented for examination in this application (10,033,997).

Acknowledge is made of information disclosure document filed December 19, 2001.

2. ***Claim Rejections - 35 USC § 102***

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1 and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Shalit (U.S. 5,875,457).

As to claim 1, Shalit discloses **A method for expanding a RAID subsystem from a first array of disk drives to a second array of disk drives** [figure 2 shows the first array of disk drives consisting of D1, D2, and D3, while figure 3A shows the second array of disk drives consisting of D1, D2, D3, and D4. D4 is the new disk drive to be added to the existing array of disk drives. Shalit's invention discloses a method and apparatus for dynamically expanding an N drive RAID set to an M drive RAID set while maintaining data integrity, where the M drive RAID set includes one or more new drives (abstract)], **the first array including a set of data disk drives storing old data and spare space** [figure 2 shows the first array of disk drives consisting of D1, D2, and D3, which store old data. Although figure 2 does not explicitly show spare space, Shalit discloses that the RAID controller will locate free space (i.e., the spare space) on one disk in the N drive RAID set (column 4, lines 11-12); that mirroring the destructive zone data by copying it to a free location in the N drive RAID set and to a location in a new drive in the M drive RAID set (column 6, lines 44-46)], **and the second array**

**including the first array and at least one new disk drive** [figure 3A shows the second array of disk drives consisting of D1, D2, D3, and D4. D4 is the new disk drive to be added to the existing array of disk drives], **comprising:**

**Distributing the old data among the set of data disk drives and at least one new disk drive** [figure 5 shows that old data (0, 1, 2, 3, 4, and 5) originally distributed among disk drives D1, D2 and D3 is copied to the new drive D4; figure 4 shows the flow diagram of a method of dynamically expanding a RAID set according to Shalit's invention, including the step of copy (X) blocks from the last arm to new drive (D4), copy destructive zone data to last arm, and copy destructive zone data to new drive. These steps effectively distribute the old data among the existing and the new disk drives] **while mapping new data to the spare space** [Shalit discloses that after identifying a destructive zone in the N drive RAID the controller will mirror the destructive zone data by copying it to a free location in the N drive RAID set and to a location in a new drive in the M drive RAID set (column 6, lines 44-46); that in the event that a write takes place (i.e., new data comes in), the copy step must be restarted so that the new data for this zone can be copied across to the new disc (column 4, lines 28-31). Since this copy step create a mirror image at both the free location in the N drive RAID set and to a location in a new drive in the M drive RAID set, the new data is effectively copied to the free location (i.e., the spare space) in the N drive RAID set as well]; **and copying, upon completion of the distribution, the new data from the spare space to the set of data disk drives and at least one new disk drive** [Shalit discloses that the RAID expansion process begins by copy a stripe at a time the data

block in the destructive zone from the original RAID set over to the expanded RAID set (column 4, lines 61-64). If any write operations (i.e. new data) to the destructive zone occur during the expansion process, the destructive zone data in both the new disc location and the free space (the free space is the counter part of the last arm, which is only used when there is no free space in the N drive RAID) location is updated (column 4, lines 67; column 5,lines 1-3). Since the free space maintains a mirror image of the destructive zone data and that new data is updated in the destructive zone as explained earlier, this effectively copies the new data, if any, from the free space to the expanded RAID set] **to enable concurrent expansion of the first array while accessing the old and new data** [data integrity is assured in the N drive RAID set during migration by maintaining mirrored destructive zone data until the expansion step is completed migration of the destructive zone of the N set RAID set (abstract), as explained earlier].

As to claim 8, Shalit discloses **determining parity for the new data from the new data and old data** [in the new expanded RAID set, each stripe will include three blocks of data spread across three of the disks in the array and a block of parity information on a fourth disk (column 3, lines 8-10). Since parity is generated using all data present in the RAID disks, including both new and old data, thus the parity information contained in the fourth disk reflects the contribution from both new and old data].

4. ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 2 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shalit (U.S. 5,875,457) as applied to claim 1 above, and further in view of Jacobson et al. (U.S. 5,615,352).

As to claim 2, Shalit does not explicitly mention **allocating the spare space on a dedicated spare disk drive**, although the element of a free location in the N drive RAID set is recited in the disclosure and plays an important role in facilitating the mirroring of the destructive zone data. A dedicated spare disk drive is one form of the free space. Further, Jacobson et al. explicitly teach the use of dedicated spare disk drives to support a method of adding storage disks to a hierarchical disk array while maintaining data availability (figure 1, item 31). A dedicated spare disk drive, although increases the cost of the system, does provide more resource to be disposed during the process of data migration, and makes the expansion procedures easier to control and consumes less time. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the benefits offered by a dedicated spare disk drive in supporting the RAID expansion process and include it in the system to further improve Shalit's scheme.

As to claim 4, Shalit does not explicitly mention **the new data be mapped redundantly**. However, Jacobson et al. disclose the use of mirror arrangement to duplicate the data (figure 1, item 18) as well as the use of parity encoding (figure 1, item 22) as means to assure data integrity through the use of redundancy. These two measurements, although increase the cost of the system, do allow the data to be recovered or reconstructed in case of corruption and thus improve the reliability of the system. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the benefits offered by these redundancy measurements in improving the reliability of the RAID expansion process and include it in the system to further enhance Shalit's scheme.

**6.** Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shalit (U.S. 5,875,457) as applied to claim 1 above, and further in view of DeKoning et al. (U.S. 6,067,635).

As to claim 3, Shalit does not explicitly mention **allocating the spare space among the first array of disk drives**, although the element of a free location in the N drive RAID set is recited in the disclosure and plays an important role in facilitating the mirroring of the destructive zone data. Allocated spare space among the first array of disk drives is one form of the free space. Further, DeKoning et al. explicitly teach the use of allocated spare space among the first array of disk drives to support preservation of data integrity in a RAID storage device (figure 2, item 30). Allocating spare space among the first array of disk drives essentially distributes the available pare space among all the existing disk drives, hence reducing the risk in which a single-point failure,

such as in the case of the malfunction of a dedicated spare disk drive, may cause the entire RAID expansion scheme to break down. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the reliability benefit offered by allocating spare space among the first array of disk drives in supporting the RAID expansion process and incorporate it into the system to further enhance Shalit's scheme.

**7.** Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shalit (U.S. 5,875,457) as applied to claim 1 above, and further in view of Verdoorn, Jr. (U.S. 5,524,204).

As to claim 5, Shalit does not explicitly mention **initializing the spare space to all zero data**. However, Verdoorn, Jr. teaches writing zeros to data blocks as part of the process to support dynamically expanding a redundant array of disk drivers (figure 3C, items 326 and 328). Initializing the spare space to all zero data allows the spare space to be in a predetermined state and make the calculation and the generation of the parity predicable and controllable, which is crucial to the process of RAID expansion. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the importance of initializing the spare space to all zero data in supporting the RAID expansion process and incorporate it into the system to further enhance Shalit's scheme.

As to claim 6, Shalit does not explicitly mention **generating parity data for the initialized spare space**. However, Verdoorn, Jr. teaches writing zeros to data blocks as part of the process to support dynamically expanding a redundant array of disk drivers,

as explained earlier (figure 3C, items 326 and 328). Further, Verdoorn, Jr. also teaches that the invention provides apparatus and method that maintains parity protection for all data within the array at all times during the expansion process (column 2, lines 21-25), and figure2 shows a number of parity blocks (noted as PRTY) being present in the array. This indicates that parity data will be generated for the initialized spare space since it is part of the array and is actively involves in the expansion process. Initializing the spare space to all zero data allows the spare space to be in a predetermined state and make the calculation and the generation of the parity predicable and controllable, which is crucial to the process of RAID expansion. Parity data allows the reconstruction of the data in case of corruption and is crucial to maintain the integrity of data. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the importance of both features in supporting the RAID expansion process and incorporate them into the system to further enhance Shalit's scheme.

As to claim 7, Shalit does not explicitly mention **initializing at least one new disk drive**. However, Verdoorn, Jr. teaches initializing at least one new disk drive as part of the process to support dynamically expanding a redundant array of disk drivers (figure 3A, item 302). Initializing one new disk drive allows the new disk drive to start in a predetermined state and make the calculation and the generation of the parity predicable and controllable, which is crucial to the process of RAID expansion. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the importance of initializing at least one new disk

drive in supporting the RAID expansion process and incorporate it into the system to further enhance Shalit's scheme.

***Claim Rejections - 35 USC § 102***

**8.** Claim 9 is rejected under 35 U.S.C. 102(b) as being anticipated by Shalit (U.S. 5,875,457).

As to claim 9, Shalit discloses **an expandable RAID subsystem, comprising:**

**A first array of disk drives including a set of data disk drives storing old data and spare space** [refer to claim analysis provided in "As to claim 1"];

**A second array of disk drives including the first array and at least one new disk drive** [refer to claim analysis provided in "As to claim 1"];

**Means for distributing the old data among the set of data disk drives and at least one new disk drive while mapping new data to the spare space** [refer to claim analysis provided in "As to claim 1"]; and

**Means for copying, upon completion of the distributing, the new data from the spare space to the set of data disk drives and at least one new disk drive to enable concurrent expansion of the first array while accessing the old and the new data** [refer to claim analysis provided in "As to claim 1"].

***Claim Rejections - 35 USC § 103***

**9.** Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shalit (U.S. 5,875,457) as applied to claim 9 above, in view of DeKoning et al. (U.S. 6,067,635), and further in view of Verdoorn, Jr. (U.S. 5,524,204).

As to claim 10, Shalit does not explicitly mention **allocating the spare space among the first array of disk drives**, although the element of a free location in the N drive RAID set is recited in the disclosure and plays an important role in facilitating the mirroring of the destructive zone data. Allocated spare space among the first array of disk drives is one form of the free space. Further, DeKoning et al. explicitly teach the use of allocated spare space among the first array of disk drives to support preservation of data integrity in a RAID storage device (figure 2, item 30). Allocating spare space among the first array of disk drives essentially distributes the available pare space among all the existing disk drives, hence reducing the risk in which a single-point failure, such as in the case of the malfunction of a dedicated spare disk drive, may cause the entire RAID expansion scheme to break down. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the reliability benefit offered by allocating spare space among the first array of disk drives in supporting the RAID expansion process and incorporate it into the system to further enhance Shalit's scheme.

Also to claim 10, Shalit does not explicitly mention **initializing the spare space to all zero data**. However, Verdoorn, Jr. teaches writing zeros to data blocks as part of the process to support dynamically expanding a redundant array of disk drivers (figure 3C, items 326 and 328). Initializing the spare space to all zero data allows the spare space to be in a predetermined state and make the calculation and the generation of the parity predicable and controllable, which is crucial to the process of RAID expansion. Therefore it would have been obvious for persons of ordinary skills in the art at the time

of applicant's invention to recognize the importance of initializing the spare space to all zero data in supporting the RAID expansion process and incorporate it into the system to further enhance Shalit's scheme.

***Claim Rejections - 35 USC § 103***

**10**. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shalit (U.S. 5,875,457) as applied to claim 9 above, in view of Jacobson et al. (U.S. 5,615,352), and further in view of Verdoorn, Jr. (U.S. 5,524,204).

As to claim 11, Shalit does not explicitly mention **allocating the spare space on a dedicated spare disk drive**, although the element of a free location in the N drive RAID set is recited in the disclosure and plays an important role in facilitating the mirroring of the destructive zone data. A dedicated spare disk drive is one form of the free space. Further, Jacobson et al. explicitly teach the use of dedicated spare disk drives to support a method of adding storage disks to a hierarchical disk array while maintaining data availability (figure 1, item 31). A dedicated spare disk drive, although increases the cost of the system, does provide more resource to be disposed during the process of data migration, and makes the expansion procedures easier to control and consumes less time. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the benefits offered by a dedicated spare disk drive in supporting the RAID expansion process and include it in the system to further improve Shalit's scheme.

Also to claim 11, Shalit does not explicitly mention **initializing the spare space to all zero data**. However, Verdoorn, Jr. teaches writing zeros to data blocks as part of

the process to support dynamically expanding a redundant array of disk drivers (figure 3C, items 326 and 328). Initializing the spare space to all zero data allows the spare space to be in a predetermined state and make the calculation and the generation of the parity predicable and controllable, which is crucial to the process of RAID expansion. Therefore it would have been obvious for persons of ordinary skills in the art at the time of applicant's invention to recognize the importance of initializing the spare space to all zero data in supporting the RAID expansion process and incorporate it into the system to further enhance Shalit's scheme.

***Conclusion***

**11.** Claims 1-11 are rejected as explained above.

**12.** Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sheng-Jen Tsai whose telephone number is 571-272-4244. The examiner can normally be reached on 8:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Kim can be reached on 571-272-4182. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Sheng-Jen Tsai
Examiner
Art Unit 2186

December 3, 2004

PIERRE BATAILLE
PRIMARY EXAMINER